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Ureteral Reflux and Residual Volumes—Minimizing Irradiation

VESICOURETERAL REFLUX IN CHILDHOOD has been clearly implicated as a cause of significant injury to the kidney. Reflux nephropathy is a complex issue and concerns both renal infection and direct renal injury caused by penetration of urine into the renal pyramid. Traditionally, children presenting with a urinary tract infection have been evaluated by intravenous urography and contrast cystography. Present methods of evaluation in many centers consist of an ultrasonogram of the kidneys with a radionuclide cystogram in female patients but a conventional contrast cystourethrogram in male patients. In either sex, cystography is done at about seven to ten days following antibiotic therapy, as it is likely that during the acute phase of an infectious process there may be sufficient bladder wall edema to prevent detection of clinically significant reflux.

Regardless of the method of initial evaluation, the radionuclide cystogram is the method of choice for sequential evaluation. The technique has been well described and it is simple to do. A small feeding catheter is aseptically inserted into the urinary bladder via the urethra. About 100 ml of sterile 0.1 normal saline is instilled into the bladder. A 250-μCi dose of technetium Tc 99m sulfur colloid is administered via intravenous tubing. The patient's bladder is then slowly filled to the point of spontaneous voiding. Continuous posterior renal scintiphotos and computer data that include the dome of the urinary bladder are obtained sequentially. A technique for indirect radionuclide cystography has been described; although it may be more physiologic, most observers feel that there is a substantial risk of missing clinically significant reflux using this method.

Following voiding, the residual urinary tract volume may be calculated. This is a simple measurement based on prevoiding and postvoiding urinary tract counts and the volume of urine voided. The amount of residual bladder volume has much less consequence than that retained in the entire collecting system, which should be determined when one calculates these values.

Although difficult to document, many observers feel that the radionuclide cystogram is more sensitive for detecting clinically significant reflux than the conventional contrast cystogram. This relates to the continuous monitoring and the greater ease of detection of small amounts of complete (to the level of the renal pelvis) reflux. The single most consequential aspect of the difference between radiographic contrast and radionuclide cystography is the radiation dose. A typical 30-minute radionuclide cystogram delivers about 30 mrads to the bladder wall, less than 5 mrads to the male gonads and about 2 to 3 mrads to the ovaries. These figures represent about 1/100th of the radiation-delivered dose from a well-done radiographic contrast cystogram.

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Bone Scintigraphy—No Diagnostic Equal

DESPITE MAJOR ADVANCES in computed tomography and nuclear magnetic resonance, bone scintigraphy remains the most sensitive and the most practical whole-body screening procedure for skeletal involvement with malignancy. For proper cost-effectiveness, however, bone scanning should be used routinely only to evaluate those malignant disorders with a substantial likelihood of skeletal dissemination. With the probability of bone scan positivity at diagnosis indicated in parentheses, these tumors include stages III and IV rhabdomyosarcoma (56%), neuroblastoma (51%), prostatic carcinoma (31.8%), Hodgkin's disease (27%), stage III breast carcinoma (22.5%) and all other lymphomas (14%). Cancers not warranting routine bone scintigraphy at diagnosis include bladder carcinoma (5% to 15%), cervical carcinoma (0% to 10%), asymptomatic bronchogenic carcinoma (6% to 8%), ovarian carcinoma (0% to 8%), uterine carcinoma (0% to 4%), head and neck cancer (1%) and stages I and II malignant melanoma (0% to 1%). In stages I and II breast carcinoma (2% to 6%), annual bone scans are appropriate to follow the disease because of the high probability of skeletal involvement at recurrence (7% to 58%).

Although 37% of bone scans are positive at diagnosis in patients with multiple myeloma, skeletal radiography is clearly superior in sensitivity. In all patients with malignancy, bone scintigraphy is appropriate to evaluate musculoskeletal pain or an elevated serum alkaline phosphatase level. In primary bone cancer, the bone scan can effectively show the extent of the primary lesion, spread to distal skeletal sites (11% to 45%) and calcified soft tissue metastases.

Among benign skeletal processes, the bone scan is useful to evaluate symptomatic osteoid osteoma (including surgical location), fibrous dysplasia, brown tumors and aneurysmal bone cysts. Its high sensitivity for acute osteomyelitis in adults (90% to 95%) can be equaled in children by the use of the three-phase bone scan. Combined with gallium 67 or indium 111-granulocyte scintigraphy, it is effective in assessing chronic osteomyelitis and in differentiating loosening from infection in joint prostheses. Subradiographic fractures, especially stress fractures, are best identified by bone scintigraphy. Paget's disease produces intensely positive labeling on a bone scan, so that bone scintigraphy is useful in evaluating the extent of pagetic skeletal involvement, including monostotic versus polyostotic Paget's disease and, to a lesser extent, in monitoring response to therapy or progression of disease. Temporomandibular joint disease is detected with 94% sensitivity by single photon emission computed tomography. The evolution of avascular necrosis (and other types of bone infarction) is well delineated by serial bone scans. Although the bone scan is abnormal in a large variety of arthritic and degenerative joint conditions, making positive findings highly nonspecific, it can be useful in establishing the presence of early inflammatory joint involvement before radio-